

9.10 Rusting

Metals high in the reactivity series corrode rapidly. Metals low in the reactivity series – such as gold – do not corrode.

The most common example of **corrosion** is rusting. When iron comes into contact with acid, oxygen and other substances in the environment it is oxidized. Hydrated iron oxides are formed. These are known as rust and have the formula $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$ where n is a small number.

Aim

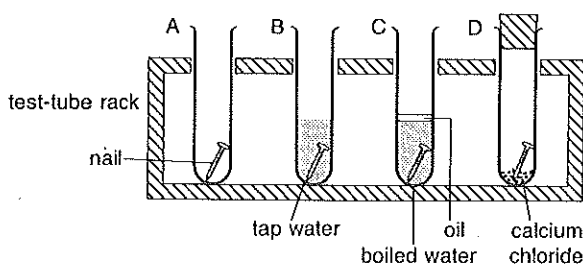
To investigate the conditions required for rusting.

Apparatus and materials

Four test-tubes
Bung
Test-tube rack
Four iron nails, about 3 cm in length
Spatula
Beaker, 100 cm³
Bunsen burner and mat
Tripod and gauze
Emery paper
Cooking oil
Calcium chloride, anhydrous lumps

Procedure

- 1 Clean four nails with emery paper.
- 2 Label four test-tubes A, B, C and D.
- 3 Place one nail in a dry test-tube A.
- 4 Place a nail in test-tube B and cover the nail with tap water.
- 5 Boil some water in the beaker for about a minute. This removes air from the water. Place a nail in test-tube C. Pour in boiled water to cover the nail. Pour in cooking oil to cover the surface of the water.
- 6 Use a spatula to place a few lumps of anhydrous calcium chloride into test-tube D. Add a nail and seal the tube with a bung.



- 7 Leave the test-tubes in a rack for 3–5 days.
- 8 After 3–5 days inspect the nails for rust.
- 9 Place the test-tubes in order of the amount of rust formed.

Results

Copy and complete the following table:

test-tube	conditions	observation	order
A	air		
B	tap water		
C	boiled water		
D	dry air		

Extra work

- Set up other test-tubes to investigate other conditions which might affect rusting. For example:
 - a) a test-tube containing a nail in dilute salt solution
 - b) a test-tube containing water and a strip of magnesium ribbon in contact with a nail
 - c) a test-tube containing a nail and anhydrous copper(II) sulphate
 - d) a test-tube containing a nail coated with commercial 'anti-rusting agent'

Questions

- 1
 - a) What is anhydrous calcium chloride used for in test-tube D?
 - b) Why is oil packed on top of the water in test-tube C?
 - c) Why is boiled water used in test-tube C?
 - d) Suggest an alternative to cooking oil for test-tube C.
 - e) Describe the appearance of rust formed in this experiment.
- 2 The above experiments on rusting used the principle of a 'control'. What is meant by a 'control' and what is meant by a 'controlled experiment'? Which of the four test-tubes is 'the control'?
- 3 List six ways of preventing rusting.
- 4 Describe, with full experimental details, how you would show that rust is a hydrated form of an iron oxide.